

NEWS & VIEWS

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Midsouth and Southeast

Phosphorus, Potassium and Lime Boost Annual Ryegrass Production in the South

IN MANY AREAS OF THE SOUTH, drought limited 1996 summer forage grass production, reduced livestock grazing, and increased the need for purchased hay and feeds. Feed grain prices are higher than in previous years. To add to these problems, cattle prices are about 25 percent lower as well. Some producers were forced to reduce herd size, while others seized the opportunity to expand their herd and to improve animal quality, provided they had sufficient grazing potential. These factors have combined to increase production costs for both cattle producers and dairymen.

To reduce purchased hay and feed bills during the winter, many cattlemen and dairymen plant, or may be planting, annual ryegrass to provide their livestock with the quantities and quality of forage/feed necessary for top animal performance. Annual ryegrass can be overseeded on perennial warm season grass pastures and hay meadows or it can be planted into a prepared seedbed. Forage is normally produced from early November until early May, which complements warm season forages and extends the forage production and grazing season. Yields typically range from 3 to 6 tons per acre, depending on the fertilization program. Ryegrass is one of the highest quality forages grown in the region. When forage is most abundant, grazing is frequently discontinued on portions of the acreage to permit harvest as hay, haylage or silage. Dairymen in Louisiana are increasingly using ryegrass as silage because of its high protein and digestibility, which make it an excellent complement to corn silage.

Knowledge of the nutrient requirements of annual ryegrass is essential to improve profitability of the livestock-forage enterprise. Several studies have shown the effects of nitrogen (N) fertilization on ryegrass production, but until recently very little information was available on the effects of phosphorus (P) and potassium (K) fertilization. Dr. Don Robinson, Louisiana State University, conducted plot studies for four years on a silt loam soil at the Idlewild Research Station near Clinton to evaluate the optimum P and K fertilization of annual ryegrass. The P and K nutrition information provided here is taken from his research results. The lime information is taken from research by Dr. Vince Haby, Texas A&M University, and Dr. Marcus Eichhorn, Louisiana State University.

Phosphorus Effects

Total annual ryegrass forage yield was essentially doubled...increasing from 2.3 to over 4.6 tons/A...when 80 to 160 lb/A of P_2O_5 were applied each year on a soil testing below 20 parts per million (ppm)...40 lb/A...in available soil P (**Table 1**). Ninety percent of the maximum yield was reached with application of 80 lb/A of P_2O_5 . At this rate, each pound of P_2O_5 resulted in a 50 lb increase in forage production. Yield continued to increase with P_2O_5 application rates up to 320 lb/A, however.

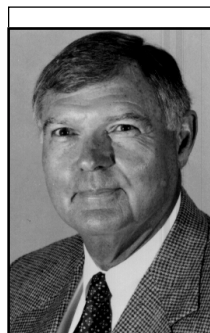
Forage P concentration was low at 0.13 percent where no P was applied. With adequate P nutrition, levels increased to



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above 0.23 percent P. As the P₂O₅ application rates increased, forage production went up, tissue P concentrations were higher and plant removal of P increased. At the optimum P rate, 20 to 30 lb of P were removed with the production of more than 4 tons/A of dry forage. Soil test P levels were initially low and did not increase to medium or high levels unless 160 to 320 lb/A P₂O₅ were applied annually. Rates of 80 lb/A or less annually did not increase soil test P levels appreciably.

Table 1. Phosphorus fertilizer influence on ryegrass yield, P removal, and soil test P levels of Tangi silt loam, 1992-1995.

P ₂ O ₅ applied ¹	Yield of dry forage	Forage:			Soil Test P, 1994	
		P ₂ O ₅ ratio	Forage P content			
lb/A/yr	tons/A	% of max.	lb/lb	%	lb/A	ppm
0	2.31	48	—	0.13	6	17
20	3.50	72	119	0.15	11	18
40	4.12	85	91	0.19	16	22
80	4.30	89	50	0.23	20	23
160	4.62	95	29	0.29	27	38
320	4.84	100	16	0.39	38	110

¹Nitrogen was applied at planting and after each harvest at 50 lb/A. Louisiana

Potassium Effects

As the K₂O application rate increased, forage yield and forage K concentration increased (**Table 2**). Ninety percent of the maximum yield was reached with an annual application of approximately 120 lb/A of K₂O, but yields continued to increase up to the 640 lb/A K₂O rate. The forage yield increase with K fertilization was not as great as that observed with P. At the 120 lb/A rate of K₂O, there were about 10 lb of dry forage produced per pound of K₂O. Fertilization at this rate resulted in a ryegrass K concentration of about 1.75 percent and a 160 lb/A K removal in the harvested forage. The high K concentrations and K removal at the 320 and 640 lb/A K₂O application rates show that the crop is capable of utilizing large quantities of K, even at these rates which are higher than necessary for 90 percent of maximum yield. Forage calcium (Ca) and magnesium (Mg) concentrations were depressed with increasing K application rates, particularly at the 320 and 640 lb/A K₂O rates. However, except at the 640 lb/A K₂O rate, the tetany index did not exceed 1.5, well below the critical 2.2 index. (Tetany is usually associated with a K/Ca+Mg ratio in forage tissue that exceeds 2.2, Mg concentration less than 0.2 percent, or a Ca concentration of less than 0.4 percent.)

Soil test K levels were low and remained low during the study (**Table 2**). In fact, soil test K dropped at all K₂O rates with the exception of the 640 lb/A rate. Potassium research with Coastal bermudagrass has shown that bermudagrass has very high K requirements and removes large quantities. When these two crops are managed together on the same field, proper K management becomes even more critical. At the very least, K fertilization rates should be based on crop removal.

Table 2. Potassium fertilizer influence on ryegrass yield, K removal, and soil test K levels of Tangi silt loam, 1992-1995.

K ₂ O applied ¹	Yield of dry forage	Forage:					Soil Test K, 1994	
		K ₂ O ratio	Forage mineral content					
lb/A/yr	tons/A	% of max.	lb/lb	%	lb/A	%	ppm	
0	4.11	80	—	1.23	102	0.31	0.67	49
20	4.30	84	19	1.25	110	0.31	0.69	35
40	4.40	86	15	1.33	116	0.30	0.66	30
80	4.53	88	11	1.56	142	0.28	0.64	31
160	4.75	93	8	1.97	188	0.27	0.61	34
320	4.90	96	5	2.64	258	0.23	0.56	23
640	5.12	100	3	3.54	362	0.18	0.46	76

¹Nitrogen was applied at planting and after each harvest at 50 lb/A. Louisiana

Returns to P and K

The costs and returns to P and K fertilization in Dr. Robinson's study are shown in **Table 3**. Comparisons were made while holding the N rate constant at 200 lb/A. Returns above fertilizer costs were calculated using the yield response data from **Tables 1 and 2** while valuing dry forage at \$60 and \$80/ton and reflect the money available to pay all other production costs. Residual effects on soil tests are not considered in these calculations.

Table 3. Costs and returns from fertilizing annual ryegrass for forage production in Louisiana¹.

Fertilizers applied, lb/A	Yield of dry forage	Total N-P ₂ O ₅ -K ₂ O Costs/A	Returns from forage			
			Total	Above fert. cost	Total	Above fert. cost
N-P ₂ O ₅ -K ₂ O	tons/A	-----\$/A-----				
200-0-120	2.31	78	185	107	139	61
200-40-120	4.41	88	330	242	247	159
200-80-120	4.30	98	344	246	258	160
200-160-120	4.62	118	370	252	277	159
200-320-120	4.84	158	387	229	290	132
200-80-0	4.11	80	329	249	247	167
200-80-60	4.47	89	358	269	268	179
200-80-120	4.64	98	371	273	278	180

¹Fertilizer costs per acre were calculated by assuming N, P₂O₅ and K₂O prices to be 30, 25 and 15¢ per pound and forage value to be \$80 and \$60 per dry ton, respectively.

Increasing P₂O₅ and K₂O rates did not greatly increase total fertilizer costs within the range where large increases in forage yield and quality also occurred. The highest net return above fertilizer costs occurred at the 160 lb/A P₂O₅ rate, when forage was valued at \$80/ton. At \$60/ton, returns above fertilizer costs were the same for rates of P₂O₅ between 40 and 160 lb/A.

At a constant P₂O₅ rate of 80 lb/A, returns per acre increased as K₂O rate increased to 120 lb/A, if the forage was valued at \$80/ton.

Economic returns above fertilizer costs were maximized at or near the rates of 80 lb/A of P₂O₅ and 120 lb/A of K₂O.

Lime Effects

On many Coastal Plain soils in the Midsouth, soil acidity is a major factor limiting forage production. Often, soil pH values range from 4.0 to 5.0, extractable Ca and Mg levels are low and extractable aluminum (Al) is high. Research by Dr. Vince Haby and others at Overton, Texas, showed that annual ryegrass yields could be increased with liming (**Table 4**). After three years of N fertilization totaling 1,214 lb/A for Coastal bermudagrass and annual ryegrass combined, the soil pH on plots receiving the 1.7 ton/A had dropped to 4.6. Still, forage yields were 5,415 lb/A. Projections of the economic value of the ryegrass response to aglime showed the monetary return over the cost of the lime, if the forage system had been grazed by 450 lb stocker cattle, would have exceeded \$400/A per year, even three years after the lime application. The marginal rate of return was predicted to have occurred beyond two tons of limestone per acre (**Table 5**).

Table 4. Soil pH and Marshall ryegrass response to aglime incorporated into a Lilbert loamy fine sand.

Aglime rate, tons/A	Fall of application year, pH	Dry matter 1984,		Dry matter 1986,		Dry matter 1987,
		lb/A	pH, 1985	lb/A	pH, 1987	lb/A
0	4.7	2,783	4.5	3,434	4.5	633
0.3	4.8	4,523	4.7	4,576	4.5	981
1.7	5.7	5,379	6.2	7,422	4.6	5,415

Texas

Table 5. Economic evaluation of estimated livestock gains from increased yield of annual ryegrass in 1986 due to liming.

Aglime application, tons/A	Ryegrass yield, dry matter lb/A	Yield increase, dry matter lb/A	Added incremental cost ¹ , \$/A	Added return ² , \$/A
0	3,233	—	—	—
0.5	5,148	1,915	12	186.00
1.0	6,503	1,355	12	132.00
1.5	7,298	795	12	77.00
2.0	7,533	235	12	23.00

Marshall variety.

¹ Aglime cost estimated at \$24/ton applied.

² Forage consumption and rates of gain estimated using a computerized simulation program. Based on \$85.00/cwt steers.

Similar work conducted by Dr. Marcus Eichhorn near Homer, Louisiana, showed that Marshall, Tetragold, and Surrey ryegrass produced higher yields than Gulf, Florida 80, and TXR-91-A7EF where lime was soil-incorporated and soil pH ranged from 4.0 to 6.6 if adequate P, K and S were also

applied. Liming significantly increased soil pH, exchangeable soil Ca and exchangeable Mg and lowered exchangeable Al. These changes resulted in significant and economic forage yield responses, especially at the 1 and 2 ton/A lime rates (**Table 6**).

Table 6. Lime increases seasonal forage yields of ryegrass and influences soil test values.

Lime tons/A	Forage yield, lb/A 1992-93	Soil analyses prior to Dec. harvest			
		pH	Ca, ppm	Mg, ppm	Al, ppm
0	2,816	4.0	79	21	106
1	8,092	4.4	222	31	68
2	8,449	5.2	414	37	24
4	8,449	5.9	641	51	3
8	8,484	6.6	1,021	48	2

Louisiana

Summary

Balanced plant nutrition, coupled with timely grazing, haying, haylage or silage harvests can result in the profitable production of quality annual ryegrass to supplement other forage systems. Soil tests should be used to determine lime and nutrient requirements. Liming strongly acid Coastal Plain soils for annual ryegrass production can result in very good returns on the investment for several years. While soil tests are an excellent starting place in formulating P and K recommendations, yield levels and P and K removal in harvested forage should also be considered. This monitoring will help prevent rapid declines in soil nutrient reserves...especially soil K... that are likely to occur with annual ryegrass production on sandy Coastal Plain soils, and possibly other soils which have a relatively low cation exchange capacity.

If ryegrass is overseeded on warm season grass pastures or hay meadows, nutrient removal should be monitored closely through yield measurements and plant tissue analyses.

Consider reducing reliance on purchased hay and supplemental feeds by developing a complete, quality forage program. Annual ryegrass has the potential to improve many forage systems which center around warm season forages by extending the grazing season. However, management must focus on adequate liming, and P and K nutrition to provide the greatest opportunity for success. Poor plant nutrition results in reduced yields and lost profits.

Reference number 96195

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